

Note to readers with disabilities: *EHP* strives to ensure that all journal content is accessible to all readers. However, some figures and Supplemental Material published in *EHP* articles may not conform to [508 standards](#) due to the complexity of the information being presented. If you need assistance accessing journal content, please contact ehp508@niehs.nih.gov. Our staff will work with you to assess and meet your accessibility needs within 3 working days.

Supplemental Material

Associations of Peripubertal Serum Dioxin and Polychlorinated Biphenyl Concentrations with Pubertal Timing among Russian Boys

Jane S. Burns, Mary M. Lee, Paige L. Williams, Susan A. Korrick, Oleg Sergeyev, Thuy Lam, Boris Revich, and Russ Hauser

Table of Contents

Table S1. Adjusted mean shifts in age at pubertal onset [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) in single organochlorine models among 473 Russian boys, enrolled at ages 8-9 years and followed up to 17-18 years

Table S2. Adjusted mean shifts in age at sexual maturity [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) in single organochlorine models among 473 Russian boys, enrolled at ages 8-9 years and followed up to 17-18 years

Table S3. Adjusted mean shifts in age at pubertal onset [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) among 473 Russian boys, adjusted for baseline body mass index and height z-scores, enrolled at ages 8-9 years and followed up to 17-18 years

Table S4. Adjusted mean shifts in age at sexual maturity [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) among 473 Russian boys, adjusted for baseline body mass index and height z-scores, enrolled at ages 8-9 years and followed up to 17-18 years

Table S1. Adjusted mean shifts in age at pubertal onset [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) in single organochlorine models among 473 Russian boys, enrolled at ages 8-9 years and followed up to 17-18 years

| Serum Quartile | Testicular Volume > 3 mL ^a | | Genitalia Stage ≥ 2 ^b | | Pubarche Stage ≥ 2 ^c | |
|---|---------------------------------------|---------|----------------------------------|---------|---------------------------------|---------|
| | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value |
| Σ TEQs ^d | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 1.9 (-3.4, 7.3) | 0.48 | 7.1 (1.2, 13.1) | 0.02 | 2.3 (-3.5, 8.0) | 0.44 |
| Q3 | 3.2 (-2.2, 8.6) | 0.24 | 6.9 (1.0, 12.9) | 0.02 | 2.1 (-3.8, 7.9) | 0.49 |
| Q4 | 5.6 (0.3, 10.9) | 0.04 | 5.7 (-0.2, 11.7) | 0.06 | 0.9 (-4.8, 6.7) | 0.75 |
| Trend test ^g | | 0.04 | | 0.08 | | 0.78 |
| Σ DLCs ^e | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 0.2 (-5.1, 5.4) | 0.96 | 4.4 (-1.4, 10.3) | 0.14 | 2.5 (-3.2, 8.2) | 0.39 |
| Q3 | 4.5 (-0.9, 9.8) | 0.10 | 7.0 (1.0, 13.0) | 0.02 | 3.1 (-2.7, 8.8) | 0.29 |
| Q4 | 4.7 (-0.5, 10.0) | 0.08 | 1.0 (-4.8, 6.9) | 0.74 | -3.6 (-9.2, 2.1) | 0.22 |
| Trend test ^g | | 0.03 | | 0.57 | | 0.27 |
| Σ Nondioxin-like-PCBs ^f | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | -0.1 (-5.5, 5.2) | 0.96 | 4.5 (-1.5, 10.4) | 0.14 | 1.0 (-4.8, 6.8) | 0.74 |
| Q3 | 0.1 (-5.2, 5.4) | 0.97 | 2.1 (-3.8, 8.0) | 0.50 | -2.5 (-8.3, 3.4) | 0.41 |
| Q4 | 0.8 (-4.6, 6.2) | 0.76 | 2.1 (-3.9, 8.1) | 0.49 | 0.3 (-5.6, 6.2) | 0.93 |
| Trend test ^g | | 0.76 | | 0.65 | | 0.78 |

Interval-censored survival models: ^aadjusted for birthweight, household income, dietary fat intake, boy's alcohol intake, boy's daily exercise; ^badjusted for birthweight, biological father living in home, parental education, daily caloric intake, boy's alcohol intake; ^cadjusted for prenatal alcohol intake, biological father living in home, daily caloric and protein intake.

^d Σ TEQ quartiles: Q1 4.0 – 14.5; Q2 14.6 – 21.0; Q3 21.1 – 33.2; Q4 33.3 – 174.7 pg/g lipid;

^e Σ DLC quartiles: Q1 122 – 280; Q2 281 – 366; Q3 367 – 486; Q4 487 – 2963 pg/g lipid;

^f Σ Nondioxin-like-PCBs quartiles: Q1 62 – 166; Q2 167 – 249; Q3 250 – 396; Q4 397 – 4248 ng/g lipid.

^gtrend tests performed by modeling OC quartiles as an ordinal variable.

Table S2. Adjusted mean shifts in age at sexual maturity [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) in single organochlorine models among 473 Russian boys, enrolled at ages 8-9 years and followed up to 17-18 years

| Serum Quartile | Testicular Volume ≥ 20 mL ^a | | Genitalia Stage 5 ^b | | Pubarche Stage 5 ^c | |
|---|---|---------|--------------------------------|---------|-------------------------------|---------|
| | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value |
| Σ TEQs ^d | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 4.2 (0.1, 8.2) | 0.04 | 3.1 (-1.3, 7.6) | 0.17 | 4.9 (-0.3, 10.0) | 0.06 |
| Q3 | 6.1 (2.0, 10.2) | 0.003 | 5.0 (0.5, 9.6) | 0.03 | 3.8 (-1.4, 8.9) | 0.16 |
| Q4 | 7.7 (3.6, 11.8) | <0.001 | 4.9 (0.4, 9.5) | 0.04 | 4.7 (-0.7, 9.6) | 0.09 |
| Trend test ^g | | <0.001 | | 0.02 | | 0.14 |
| Σ DLCs ^e | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 0.6 (-3.5, 4.7) | 0.77 | -0.4 (-4.8, 4.1) | 0.88 | 8.0 (2.6, 13.4) | 0.004 |
| Q3 | 4.1 (-0.03, 8.1) | 0.05 | 1.4 (-3.1, 6.0) | 0.54 | 7.7 (2.4, 13.1) | 0.005 |
| Q4 | 5.0 (0.9, 9.1) | 0.02 | 0.5 (-4.1, 5.0) | 0.85 | 4.4 (-0.9, 9.6) | 0.10 |
| Trend test ^g | | 0.005 | | 0.67 | | 0.13 |
| Σ Nondioxin-like-PCBs ^f | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | -1.7 (-5.8, 2.4) | 0.42 | -0.2 (-4.7, 4.2) | 0.92 | 5.7 (0.3, 11.1) | 0.04 |
| Q3 | 3.0 (-1.2, 7.1) | 0.16 | 3.0 (-1.6, 7.5) | 0.21 | 4.6 (-0.8, 10.1) | 0.09 |
| Q4 | 2.3 (-1.8, 6.4) | 0.27 | 0.05 (-4.5, 4.6) | 0.98 | 4.8 (-0.6, 10.2) | 0.08 |
| Trend test ^g | | 0.11 | | 0.66 | | 0.12 |

Interval-censored survival models: ^aadjusted for birthweight, biological father living in home, parental education; ^badjusted for mother's age at son's birth, household income, daily caloric intake, boy's daily exercise; ^cadjusted for prenatal tobacco smoke, biological father living in home.

^d Σ TEQ quartiles: Q1 4.0 – 14.5; Q2 14.6 – 21.0; Q3 21.1 – 33.2; Q4 33.3 – 174.7 pg/g lipid;

^e Σ DLC quartiles: Q1 122 – 280; Q2 281 – 366; Q3 367 – 486; Q4 487 – 2963 pg/g lipid;

^f Σ Nondioxin-like-PCBs quartiles: Q1 62 – 166; Q2 167 – 249; Q3 250 – 396; Q4 397 – 4248 ng/g lipid.

^gtrend tests performed by modeling OC quartiles as an ordinal variable.

Table S3. Adjusted mean shifts in age at pubertal onset [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) among 473 Russian boys, adjusted for baseline body mass index and height z-scores, enrolled at ages 8-9 years and followed up to 17-18 years

| Serum Quartile | Testicular Volume > 3 mL ^a | | Genitalia Stage ≥ 2 ^b | | Pubarche Stage ≥ 2 ^c | |
|---|---------------------------------------|---------|----------------------------------|---------|---------------------------------|---------|
| | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value |
| Σ TEQs, adjusted for Σ nondioxin-like-PCBs ^d | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 3.0 (-2.7, 8.6) | 0.30 | 6.8 (0.5, 13.1) | 0.04 | 2.7 (-3.6, 9.1) | 0.40 |
| Q3 | 6.1 (-0.5, 14.4) | 0.07 | 8.3 (0.9, 15.7) | 0.03 | 3.5 (-4.0, 11.0) | 0.36 |
| Q4 | 11.4 (3.9, 18.8) | 0.003 | 9.7 (1.5, 18.0) | 0.02 | 2.9 (-5.5, 11.3) | 0.50 |
| Trend test ^g | | 0.002 | | 0.03 | | 0.48 |
| Σ DLCs, adjusted for Σ nondioxin-like-PCBs ^e | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | -0.1 (-5.5, 5.3) | 0.97 | 2.0 (-4.1, 8.0) | 0.53 | 1.5 (-4.6, 7.6) | 0.63 |
| Q3 | 5.2 (-0.8, 11.2) | 0.09 | 4.7 (-1.9, 11.3) | 0.17 | 1.8 (-4.8, 8.4) | 0.60 |
| Q4 | 8.8 (2.1, 15.5) | 0.01 | 0.8 (-6.8, 8.3) | 0.84 | -5.9 (-13.3, 1.6) | 0.12 |
| Trend test ^g | | 0.004 | | 0.63 | | 0.20 |
| Σ Nondioxin-like-PCBs, adjusted for Σ TEQs ^f | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | -6.2 (-11.9, -0.4) | 0.04 | -3.1 (-9.4, 3.3) | 0.34 | -3.1 (-9.5, 3.4) | 0.35 |
| Q3 | -9.1 (-15.7, -2.5) | 0.007 | -8.2 (-15.5, -0.9) | 0.03 | -8.0 (-15.5, -0.5) | 0.04 |
| Q4 | -12.1 (-19.9, -4.4) | 0.002 | -9.8 (-18.4, -1.2) | 0.03 | -5.2 (-14.0, 3.5) | 0.24 |
| Trend test ^g | | 0.002 | | 0.01 | | 0.15 |

Interval-censored survival models: ^aadjusted for birthweight, household income, dietary fat intake, boy's alcohol intake, boy's daily exercise; ^badjusted for birthweight, biological father living in home, parental education, daily caloric intake, boy's alcohol intake; ^cadjusted for prenatal alcohol intake, biological father living in home, daily caloric and protein intake.

^d Σ TEQ quartiles: Q1 4.0 – 14.5; Q2 14.6 – 21.0; Q3 21.1 – 33.2; Q4 33.3 – 174.7 pg/g lipid;

^e Σ DLC quartiles: Q1 122 – 280; Q2 281 – 366; Q3 367 – 486; Q4 487 – 2963 pg/g lipid;

^f Σ Nondioxin-like-PCBs quartiles: Q1 62 – 166; Q2 167 – 249; Q3 250 – 396; Q4 397 – 4248 ng/g lipid.

^gtrend tests performed by modeling OC quartiles as an ordinal variable.

Table S4. Adjusted mean shifts in age at sexual maturity [months (95% CI)] by quartiles of serum dioxin-like compounds (DLCs), toxic equivalents (TEQs), and nondioxin-like polychlorinated biphenyls (PCBs) among 473 Russian boys, adjusted for baseline body mass index and height z-scores, enrolled at ages 8-9 years and followed up to 17-18 years

| Serum Quartiles | Testicular Volume ≥ 20 mL ^a | | Genitalia Stage 5 ^b | | Pubarche Stage 5 ^c | |
|---|---|---------|--------------------------------|---------|-------------------------------|---------|
| | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value | Mean shift (95% CI) | P-value |
| Σ TEQs, adjusted for Σ nondioxin-like-PCBs ^d | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 5.2 (1.0, 9.4) | 0.02 | 3.1 (-1.5, 7.8) | 0.18 | 2.9 (-2.7, 8.4) | 0.32 |
| Q3 | 7.5 (2.6, 14.4) | 0.003 | 5.7 (0.3, 11.0) | 0.04 | 1.3 (-5.2, 7.8) | 0.69 |
| Q4 | 11.4 (5.8, 17.0) | <0.001 | 8.7 (2.5, 14.9) | 0.006 | 3.7 (-3.8, 11.2) | 0.34 |
| Trend test ^g | | <0.001 | | 0.006 | | 0.43 |
| Σ DLCs, adjusted for Σ nondioxin-like-PCBs ^e | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | 0.5 (-3.6, 4.7) | 0.80 | -2.0 (-6.6, 2.6) | 0.39 | 4.7 (-0.9, 10.2) | 0.10 |
| Q3 | 3.7 (-0.9, 8.1) | 0.11 | -0.2 (-5.1, 4.8) | 0.95 | 4.2 (-1.7, 10.1) | 0.16 |
| Q4 | 6.1 (0.9, 11.3) | 0.02 | 0.5 (-5.2, 6.3) | 0.96 | 2.3 (-4.4, 9.1) | 0.50 |
| Trend test ^g | | 0.02 | | 0.75 | | 0.51 |
| Σ Nondioxin-like-PCBs, adjusted for Σ TEQs ^f | | | | | | |
| Q1 | Reference | | Reference | | Reference | |
| Q2 | -7.4 (-11.6, -3.2) | <0.001 | -5.5 (-10.1, -0.9) | 0.02 | -0.4 (-6.1, 5.3) | 0.89 |
| Q3 | -6.1 (-11.0, -1.2) | 0.02 | -5.5 (-10.9, -0.04) | 0.05 | -2.8 (-9.3, 3.7) | 0.40 |
| Q4 | -9.8 (-15.6, -4.1) | <0.001 | -10.4 (-16.7, -4.1) | 0.001 | -3.5 (-11.2, 4.2) | 0.37 |
| Trend test ^g | | 0.002 | | 0.003 | | 0.29 |

Interval-censored survival models: ^aadjusted for birthweight, biological father living in home, parental education; ^badjusted for mother's age at son's birth, household income, daily caloric intake, boy's daily exercise; ^cadjusted for prenatal tobacco smoke, biological father living in home.

^d Σ TEQ quartiles: Q1 4.0 – 14.5; Q2 14.6 – 21.0; Q3 21.1 – 33.2; Q4 33.3 – 174.7 pg/g lipid;

^e Σ DLC quartiles: Q1 122 – 280; Q2 281 – 366; Q3 367 – 486; Q4 487 – 2963 pg/g lipid;

^f Σ Nondioxin-like-PCBs quartiles: Q1 62 – 166; Q2 167 – 249; Q3 250 – 396; Q4 397 – 4248.

^gtrend tests performed by modeling OC quartiles as an ordinal variable.